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# ARM Facilities Newsletter

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## Global Warming and Methane

Global warming, an increase in Earth's near-surface temperature, is believed to result from the buildup of what scientists refer to as "greenhouse gases." These gases include water vapor, carbon dioxide, methane, nitrous oxide, ozone, perfluorocarbons, hydrofluorocarbons, and sulfur hexafluoride. Greenhouse gases can absorb outgoing infrared (heat) radiation and re-emit it back to Earth, warming the surface. Thus, these gases act like the glass of a greenhouse enclosure, trapping infrared radiation inside and warming the space.

One of the more important greenhouse gases is the naturally occurring hydrocarbon methane. Methane, a primary component of natural gas, is the second most important contributor to the greenhouse effect (after carbon dioxide). Natural sources of methane include wetlands, fossil sources, termites, oceans, freshwaters, and non-wetland soils. Methane is also produced by

human-related (or anthropogenic) activities such as fossil fuel production, coal mining, rice cultivation, biomass burning, water treatment facilities, waste management operations and landfills, and domesticated livestock operations (Figure 1). These anthropogenic activities account for approximately 70% of the methane emissions to the atmosphere.

Methane is removed naturally from the atmosphere in three ways. These methods, commonly referred to as sinks, are oxidation by chemical reaction with tropospheric hydroxyl ion, oxidation within the stratosphere, and microbial uptake by soils. In spite of their important role in removing excess methane from the atmosphere, the sinks cannot keep up with global methane production. Methane concentrations in the atmosphere have increased by 145% since 1800. Increases in atmospheric methane roughly parallel world population growth, pointing to anthropogenic sources as the cause (Figure 2). Increases in the methane concentration reduce Earth's natural cooling efficiency by trapping more of the outgoing

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terrestrial infrared radiation, increasing the near-surface temperature.

Two factors make methane a good target for counteracting the greenhouse effect. The first is methane's ability to trap and re-emit infrared radiation. Methane is 21

anthropogenic methane emissions: China, the former Soviet Union, India, the United States, and Brazil (in that order). In the United States, the U.S. Environmental Protection Agency (EPA) sponsors voluntary programs, providing technical support to help industries and others

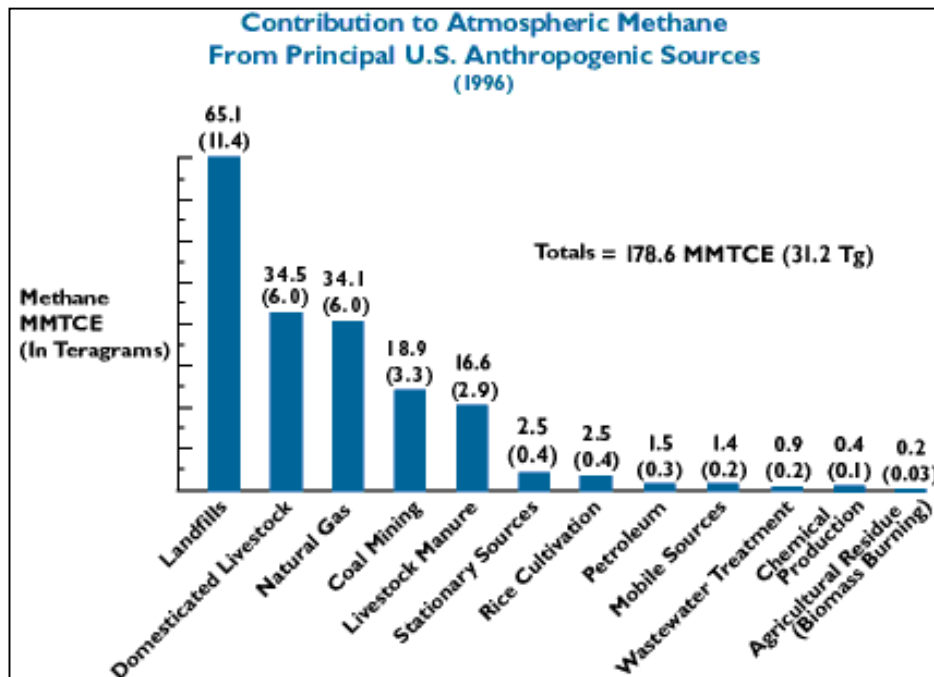


Figure 1. Anthropogenic sources of methane. (Source: EPA.)

times more effective at trapping heat in the atmosphere than is carbon dioxide, making methane a more harmful and potent greenhouse gas constituent. The second factor is methane's chemical lifetime in the atmosphere, which at 12 years is relatively short compared to the 120-year life span of carbon dioxide. This means that decreasing methane production will have greater and more immediate benefits than decreasing carbon dioxide production.

Over the past decade, the rate at which methane concentrations are increasing has slowed somewhat, in response to worldwide efforts to reduce methane emissions. Internationally, five nations are responsible for almost half of the

reduce methane production. In addition, the U.S. Department of Agriculture (USDA) and the EPA have two joint programs aimed at methane reduction on farms.

The first USDA-EPA program, the Ruminant Livestock Efficiency Program (RLEP), is designed to help livestock producers make their operations more efficient with respect to production versus methane output. The EPA reports that one cow produces 75–265 pounds of methane each year. With the U.S. cattle population estimated at 100 million head, the amount of methane emitted reaches nearly 6 million tons annually. This is a significant amount, representing about 19% of total U.S. methane emissions. The

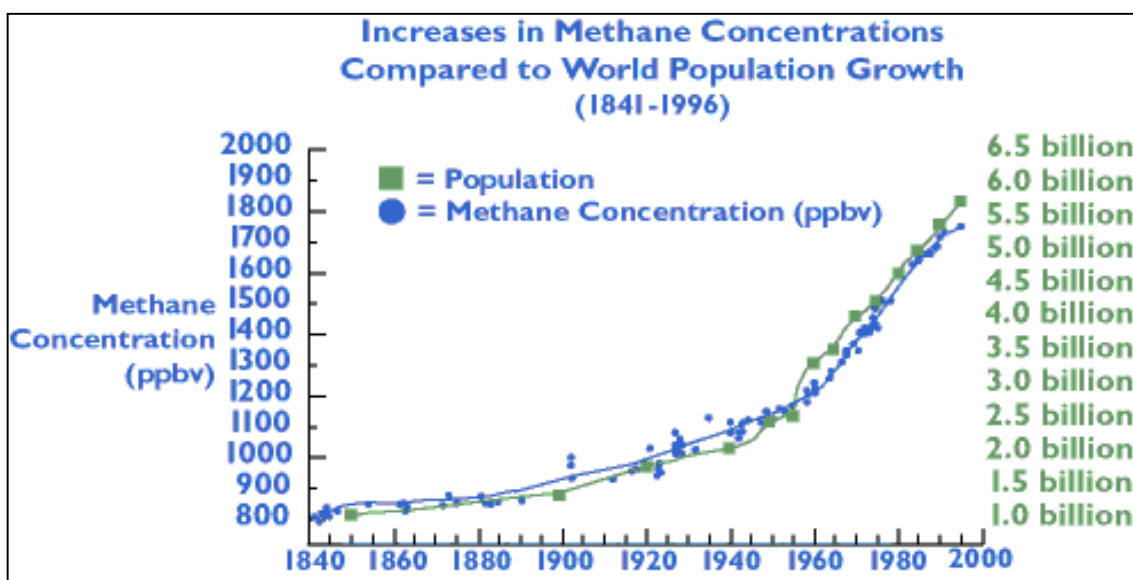


Figure 2. Increase in methane concentration compared to population. (Source: EPA.)

total methane emission by all ruminant animals worldwide is about 80 million tons, or 22% of global methane emissions. Scientists have been investigating means of reducing methane emissions in the digestive process that is unique to the ruminant animals. This process is called enteric fermentation, and methane is a by-product. The most promising method for improving production while reducing methane emissions is a more nutritious diet, achieved by better grazing and dietary supplements. Increased milk production per animal can allow dairy farmers to decrease the number of cows they feed (and the amount of total methane released to the atmosphere) but still produce the same amount of milk.

A second USDA-EPA program is AgSTAR, designed to promote the use of livestock manure as an energy resource. The waste management system used allows farmers to collect methane released by the waste as it decays anaerobically. The waste is collected in a covered digester lagoon. The methane can either be burned via a flare or used to run electrical generators. The electricity produced by a generator can be sold back to the electrical company, and

the heat from the generator can heat water for heating buildings or to maintain the temperature of the digester lagoon and ensure that the waste is broken down. Once the methane is removed, the waste is used as fertilizer for fields. Such an operation not only saves farmers money for energy costs, but it also greatly reduces methane emissions to the atmosphere. Another significant benefit is that this application controls odors. To paraphrase the poet Robert Frost, good waste management makes good neighbors.

### On the Internet:

For more information on methane, global warming, and USDA-EPA programs, see the following:

- EPA (<http://www.epa.gov/ghginfo/>)
- USDA Global Change Program Office (<http://www.usda.gov/oce/gcpo/>)
- RLEP (<http://www.epa.gov/rlep/>)
- AgSTAR (<http://www.epa.gov/agstar/>)